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The Application of Magnetic Methods for Dutch Archaeological Resource Management

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7 Magnetic mapping of archaeological features in The Netherlands

In this chapter examples are given of the magnetic anomalies that are caused by archaeological features in The Netherlands. For each type of archaeological feature, e.g. pit, ditch and well, one or more sets of magnetometer data, which have been collected within the framework of this study, have been displayed. Most of the interpretations have been confirmed by excavation, hand augering or evidence from historical maps. In some cases, the magnetometer data has been interpolated or filtered to improve the clarity of the graphical representation of the data, this has been mentioned in the caption of the figures. All the data that is presented here are subsets of larger magnetometer datasets, the data can be viewed in its original context in Appendix I, where additional information on the surveys can also be found.

7.1 Settlements

7.1.1 Pits

Continued on next page with Figure 46.

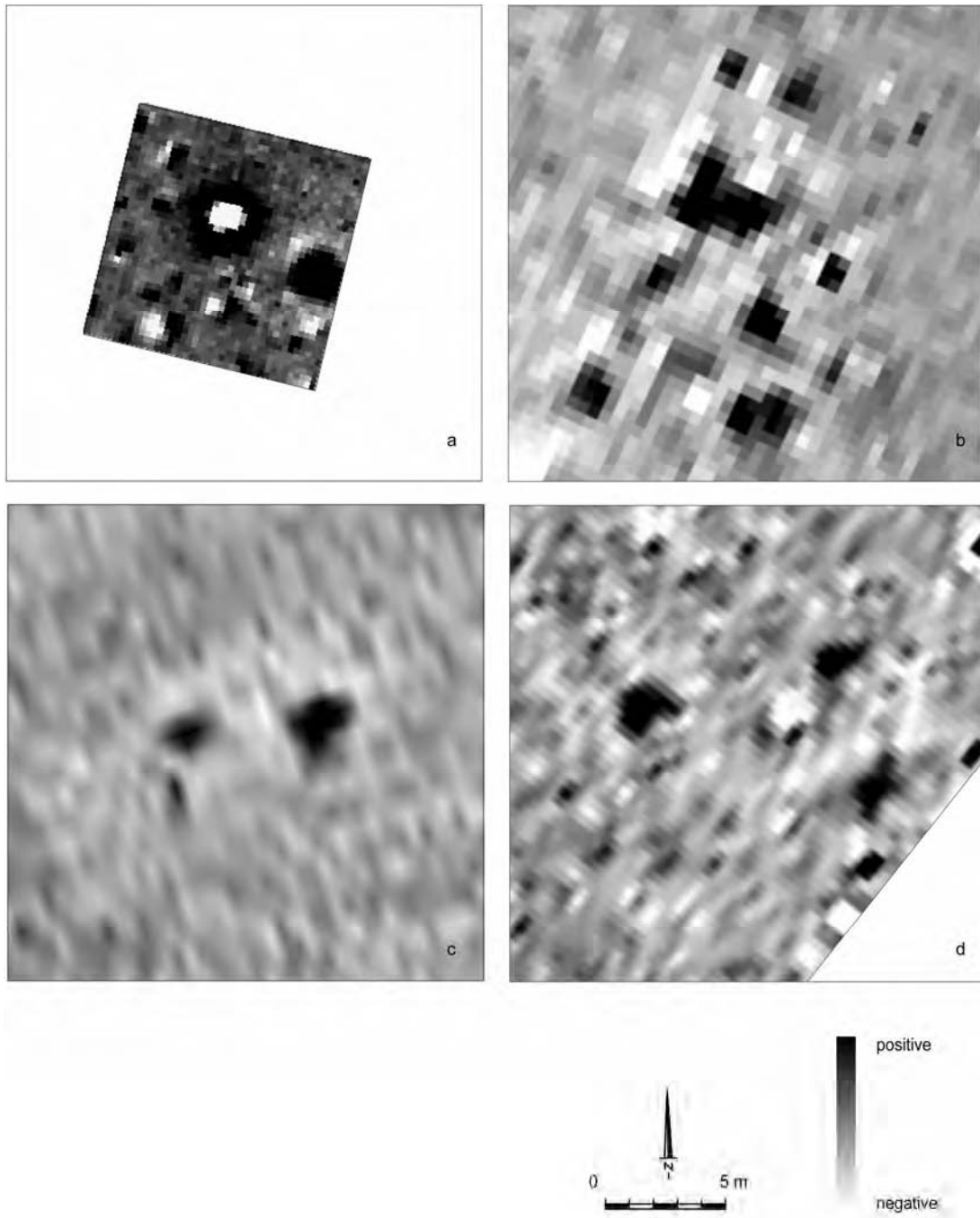


Figure 46 Examples of the magnetic response of buried archaeological pits. Pits generally cause a positive magnetic anomaly with a negative halo or a negative trough north of the positive component.

a: A rubbish pit (right hand side) is represented by an oval shaped positive magnetic anomaly (induced) with a negative halo. In the center the response of a remanent object or feature can be seen (e.g. a piece of metal), in this case the core of the anomaly is negative, and the halo around it is positive, the opposite of an induced magnetic anomaly. Data from Heeten, confirmed by excavation. Data range -3 to 3 nT.

b: Series of seven possible pits in Meerssen, each pit is defined by a positive magnetic anomaly and a negative trough on its north side. The two southern pits have been confirmed by excavation. Data range -2 to 4 nT; data has been interpolated.

c: Two possible pits in Beugen, which are mainly defined by a positive magnetic anomaly. The interpretation has not yet been confirmed by excavation. Data range -2 to 3 nT; data has been interpolated.

d: Three possible pits in Borgharen. Note the difference between the pits - positive magnetic anomalies with a small negative component, typical induced anomalies- and the magnetic noise around the proposed pits - small positive anomalies with a larger negative component or with a randomly oriented negative trough, typical responses of remanent objects like bricks or small pieces of metal. The interpretation has not yet been confirmed by excavation. Data range -3 to 3 nT; data has been interpolated.

7.1.2 Ditches

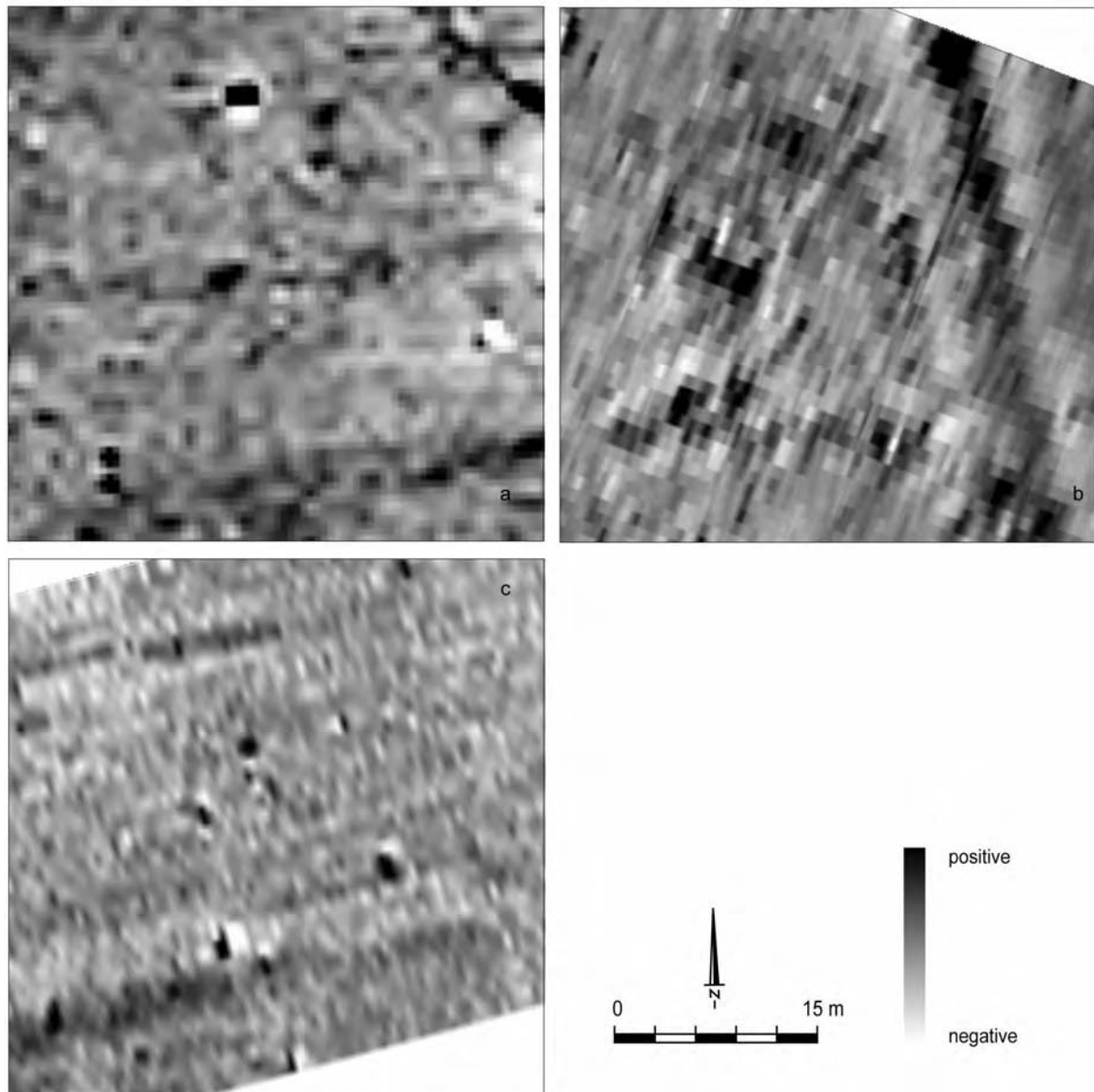


Figure 47 Examples of the magnetic response of buried ditches.

a: Four ditches in Limmen, which have been confirmed by excavation. At the bottom of the figure a patchy positive linear runs SWW-NEE, the second ditch is located in the middle of the figure and runs in approximately the same direction. The third ditch, in the northeast corner, produces a far more consistent anomaly and proved to have a high magnetic susceptibility fill. The fourth ditch is located to the west of it, the semi oval shape of the ditch can be recognized in the magnetic anomaly (see Appendix I for the interpretation diagram). Data range -2 to 4 nT; data has been interpolated.

b: Two ditches at right angles, the clearest anomaly is caused by a north-south oriented ditch on the east side of the figure. The second ditch can be recognized in the bottom half of the figure, and has an east-west orientation. The reason why the first ditch causes a much clearer magnetic anomaly than the second can probably be attributed to the difference in depth (and volume) of the two ditches. The features were investigated by hand auger. The data was collected in Polre. Data range -7 to 7 nT; data has been interpolated.

c: Two ditches with a slightly different orientation in Beugen, the first in the top of the figure, the second in the bottom. Interpretation has not yet been confirmed by excavation, and it is not clear if the proposed ditches belong to the settlement that was excavated in this area. Data range -2 to 3 nT; data has been interpolated.

7.1.3 Walls

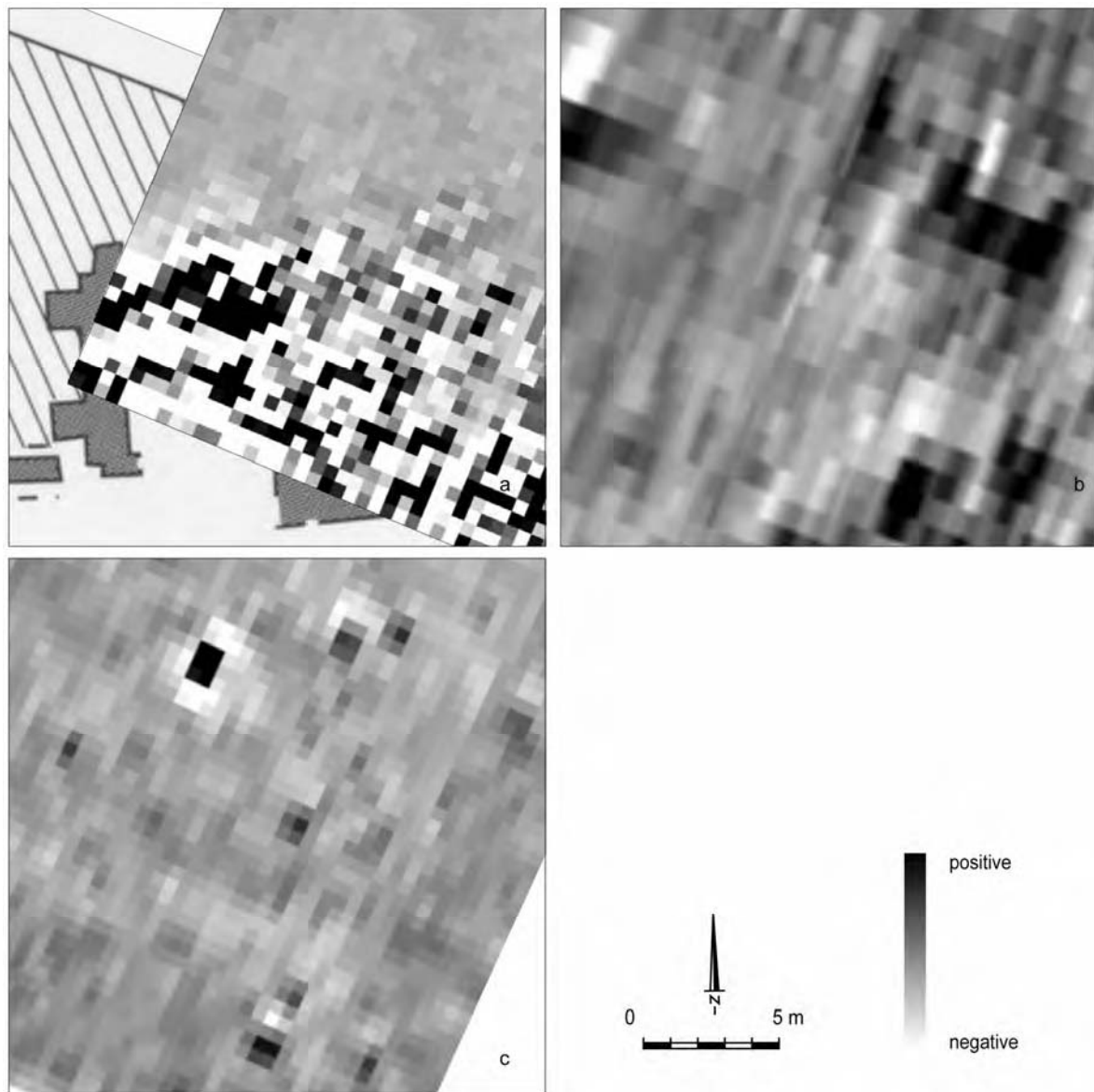


Figure 48 Examples of the magnetic response of superficial and buried brick and limestone walls.

a: The magnetic response of a brick wall that is visible on the surface, superimposed on the plan of the church of Valkenisse. There is a clear distinction between the area with and without brick. The magnetic response consists of many bipolar anomalies with random orientations, caused by the different directions of remanent magnetization in the individual bricks which are no longer *in situ*. The northern wall of the choir of the church shows a more consistent anomaly, apparently there is a dominant direction of magnetization in the bricks that make up the wall. Data range -6 to 10 nT.

b: Three areas of buried brick walls or foundations in the drowned village of Polre, on the projected location of the church. All magnetic anomalies have a positive and a randomly oriented negative component. The first anomaly is located in the southeastern corner, the presence of solid brickwork was confirmed by means of hand auger. The second and third anomaly can be recognized as strongly positive anomalies with a negative component in the top half of the figure. Data range -7 to 7 nT; data has been interpolated.

c: Two linear negative magnetic anomalies on a Roman villa site in Meerssen. The first anomaly is parallel to the grid edge, and approximately 4 meters away from it. The second negative anomaly is at right angles to it, in the bottom half of the figure. The interpretation of these anomalies remains speculative, but this is the type of response that can be expected from a buried limestone wall in a higher magnetic susceptibility matrix. Data range -2 to 4 nT; data has been interpolated.

7.1.4 Wells

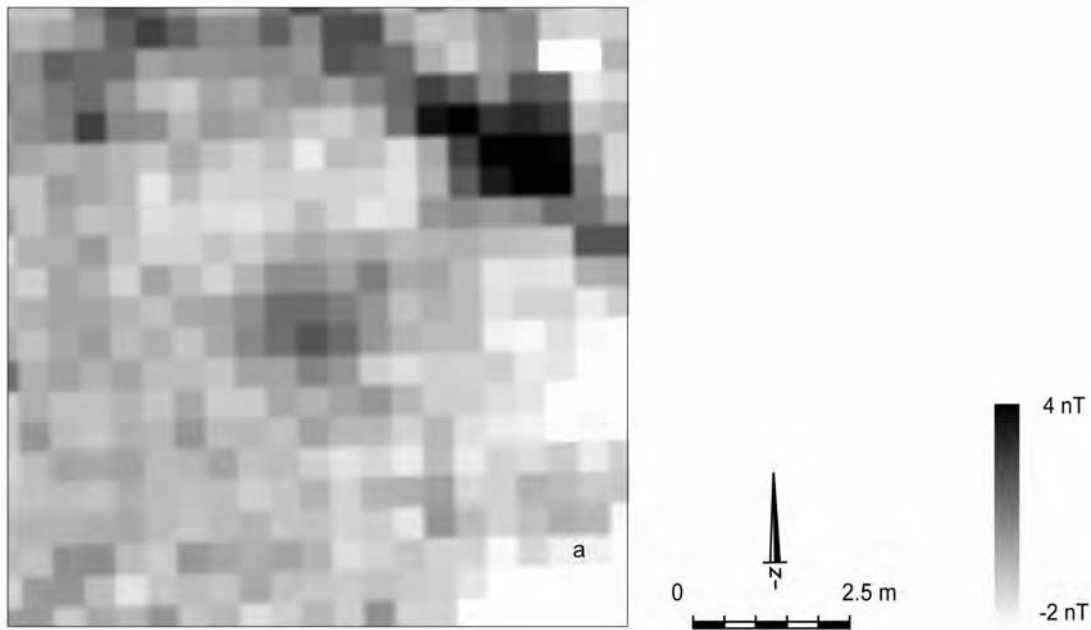


Figure 49 An example of the magnetic anomaly caused by a buried well in Limmen. The positive anomaly that was caused by the well can be seen in the center of the dataset. For comparison, the much stronger positive anomalies along the top edge are caused by buried ditches. It is likely that the magnetic susceptibility enhancement of the well deposits has taken place in the deeper, primary deposits which are rich in organic matter. See Appendix I for more details.

7.2 Off-site

7.2.1 Plough marks

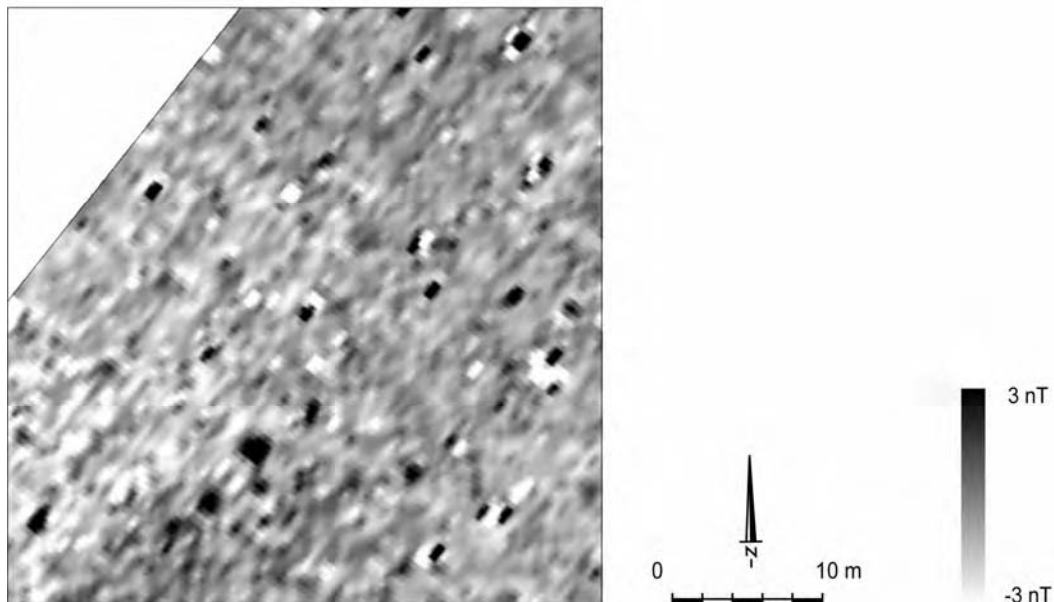


Figure 50 An example of striping in a magnetometer dataset, which is caused by ploughing. Plough marks are parallel to the edge of the magnetometer survey. Higher magnetic susceptibility material from the topsoil is ploughed into the lower magnetic susceptibility subsoil, resulting in linear positive magnetic anomalies in the location of the furrows. In this case the ploughing is modern, but ancient plough marks could have a similar magnetic response. Data from Borgharen.

7.2.2 Ditches

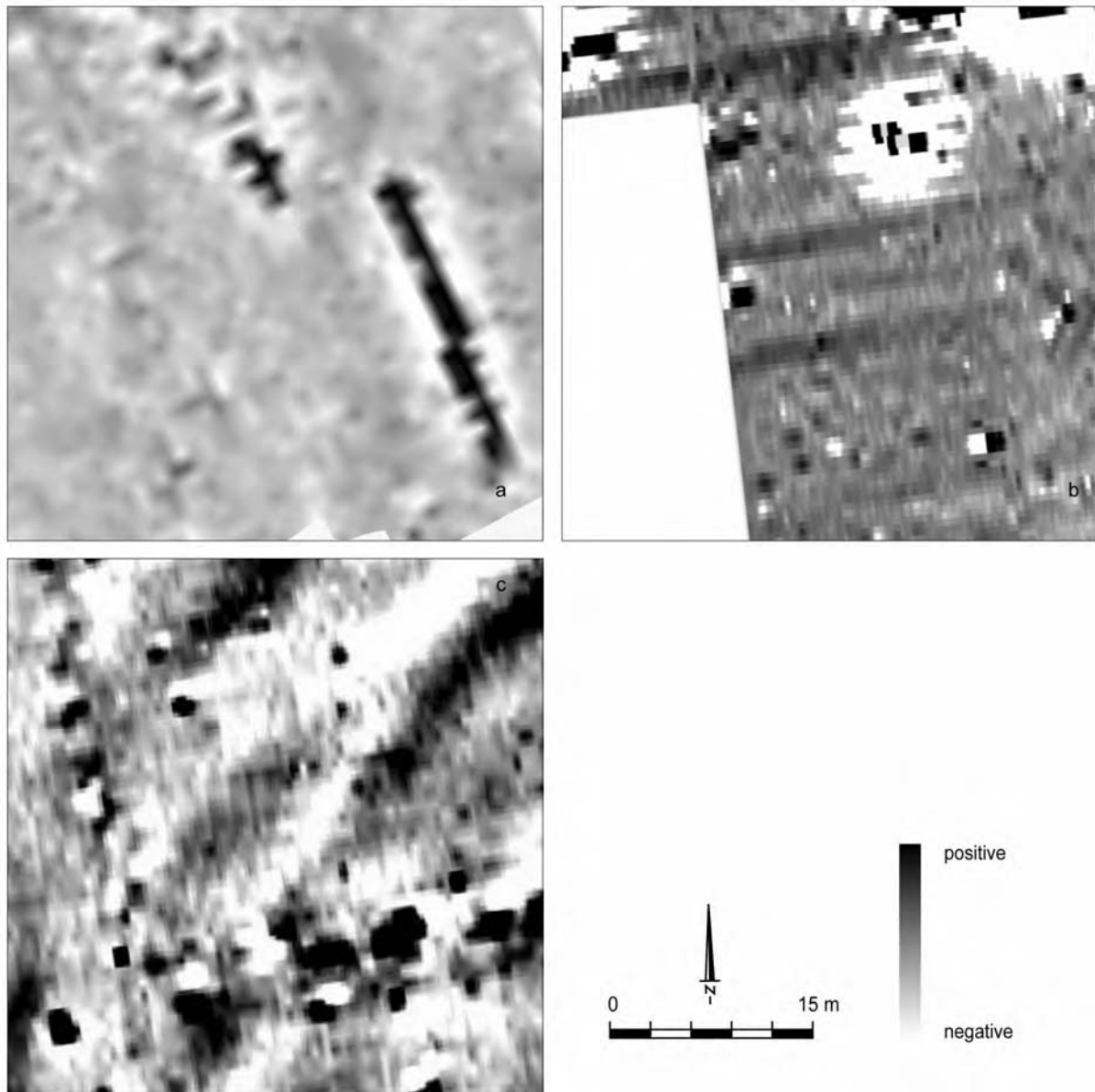


Figure 51 Examples of the magnetic anomalies that are caused by buried ditches.

a: Harnaspolder, a strong positive magnetic anomaly with a negative halo on the right hand side of the figure is caused by a post Medieval ditch which is buried at shallow depth. The feature was investigated by hand auger. The fill of the ditch has an enhanced magnetic susceptibility, and holds some remanent magnetic inclusions like pieces of brick. A second ditch can be seen in the northwestern corner of the figure, it appears to be less coherent than the first ditch. It has not been investigated by hand auger. The striping which is visible in the anomalies is caused by stepping errors. Data has been low pass filtered. Data range -1 to 3 nT.

b: Three, possibly four parallel ditches show as positive anomalies in data from Ossensisse. The ditches were first recognized on an aerial photograph, no intrusive investigations have been undertaken. Data has been interpolated, the range is -2 to 4 nT.

c: An example of the magnetic response of two field boundary ditches, the first ditch can be followed from the northwest corner in south-southwest direction, the second ditch is at right angles to the first in the bottom half of the figure. The location of the ditches is defined by the presence of bipolar magnetic anomalies, which are likely to be caused by remanent objects. The fill of the ditches may contain metal, brick or slag material. The response is much different and easy to distinguish from the geological responses which dominate the rest of the figure. The interpretation of the ditches is based on the historical map of 1832, which displays them. Data has been interpolated, the range is -1 to 2 nT.

7.2.3 Watering pits

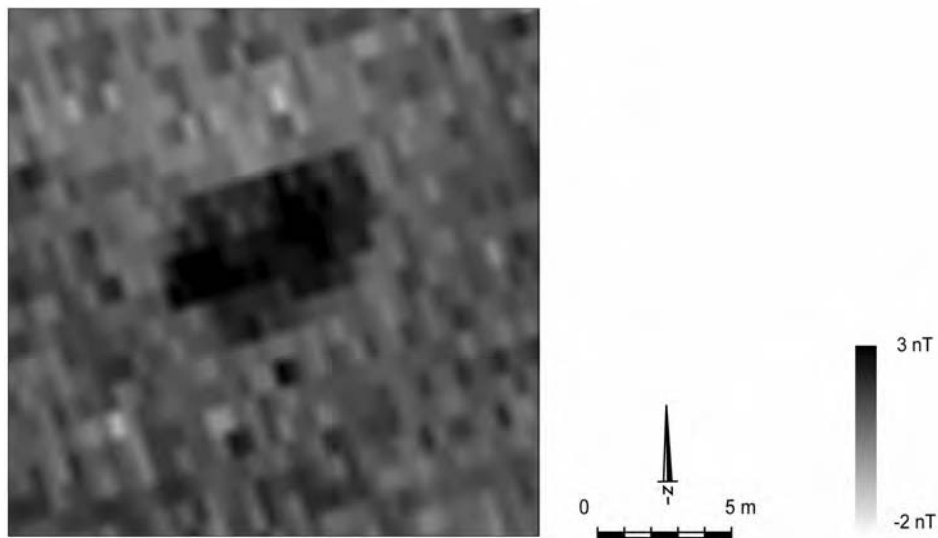


Figure 52 An example of the anomaly that was caused by a buried watering pit, it consists of a positive magnetic anomaly with a slight negative trough at its north side. The feature was investigated by hand auger, the enhanced magnetic susceptibility fill contained pottery and charcoal. The interpretation of the feature has been based on the results of the excavations in the immediate vicinity. Excavations that could confirm the interpretation have not yet been conducted. Details can be found in Appendix I.

7.3 Funerary structures

7.3.1 Graves

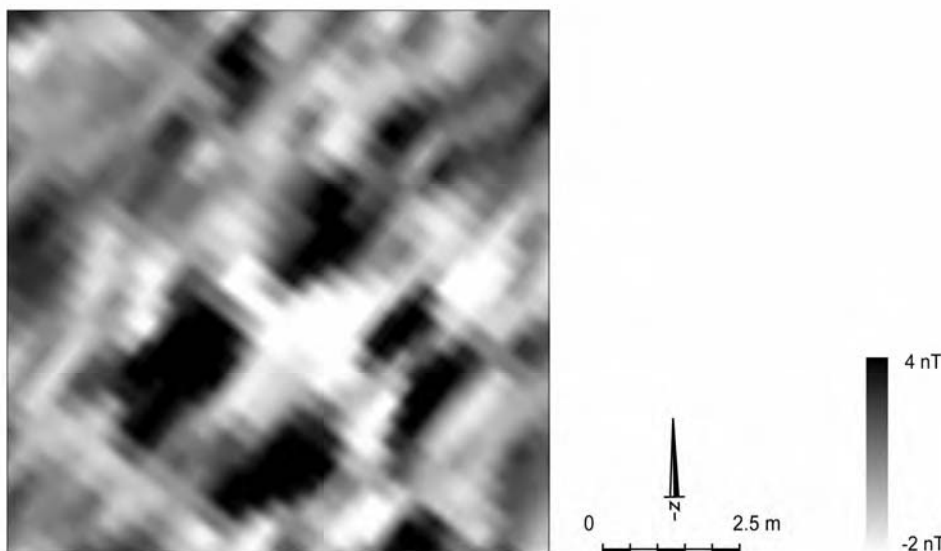


Figure 53 An example of the magnetic response of three, possibly four buried graves in Borgharen. The linear negative anomaly in the southwestern corner of the figure indicates the location of the trial trench in which a number of Medieval graves were uncovered. The shape, size and direction of the positive component of the magnetic anomalies that can be seen in the magnetometer data corresponds well to the shape, size and direction of the excavated graves. Two anomalies are located directly to the northeast of the trial trench, a third anomaly due north of the eastern anomaly. It is likely that the grave fill has an enhanced magnetic susceptibility, which is causing the magnetic anomaly. A possible fourth anomaly can be seen due east of the western anomaly, it appears to consist of two anomalies rather than one. Excavations that could confirm the interpretation of the data have not yet taken place. Data has been interpolated. More details can be found in Appendix I.

7.3.2 *Tumuli (ring gullies)*

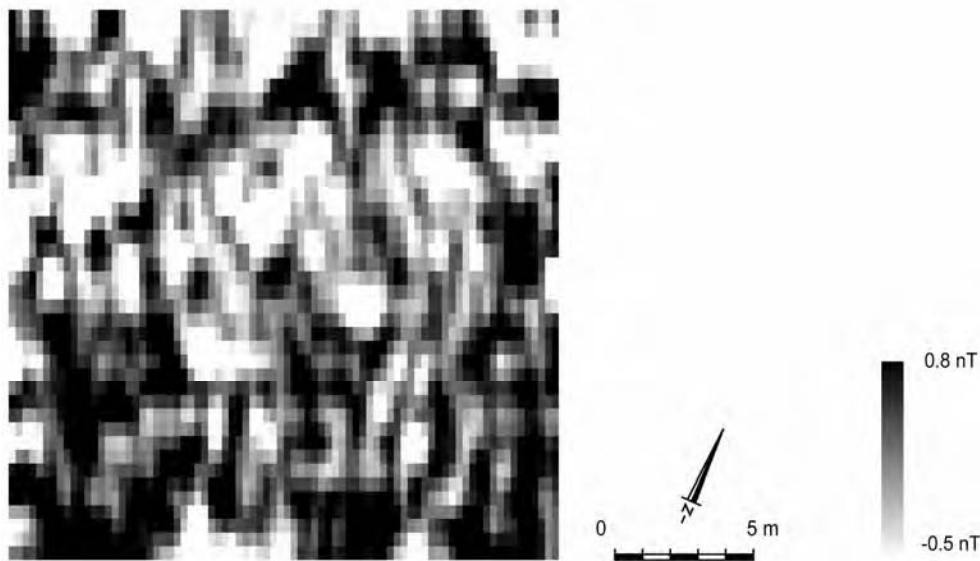


Figure 54 An example of the magnetic response of a possible ring gully in Ossensisse. The circular positive magnetic anomaly is located in the northeastern corner of the dataset, and measures approximately 13 meters in diameter. Two triangular shaped positive anomalies on the northwestern side of the anomaly may indicate the location of a gap in the ring gully. A circular crop mark, which is part of a larger group of similar crop marks (see Appendix I) was seen in this location on aerial photographs. The interpretation of the features as funerary structures remains speculative until intrusive investigations have taken place. Data has been low pass filtered and interpolated.

7.4 Industrial

7.4.1 *Peat ties and extraction pits*

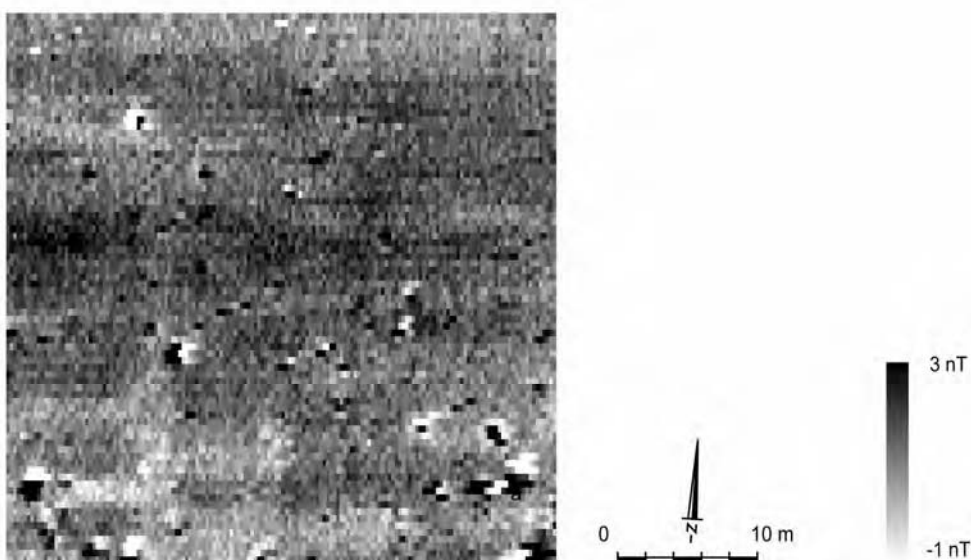


Figure 55 In Smokkelhoek, there is a magnetic difference between the presence and the absence of peat in the subsoil. Peat has a much lower magnetic susceptibility than the clastic sediment surrounding it. The peat has been partly extracted from pits. These pits have become filled in with clastic material, resulting in a positive magnetic contrast with the peat that is still in place. In the bottom left corner of the figure, linear negative magnetic anomalies can be observed, these are caused by in situ peat, whereas around these anomalies the peat has been extracted. This interpretation has been confirmed by hand augering.

7.4.2 Furnaces

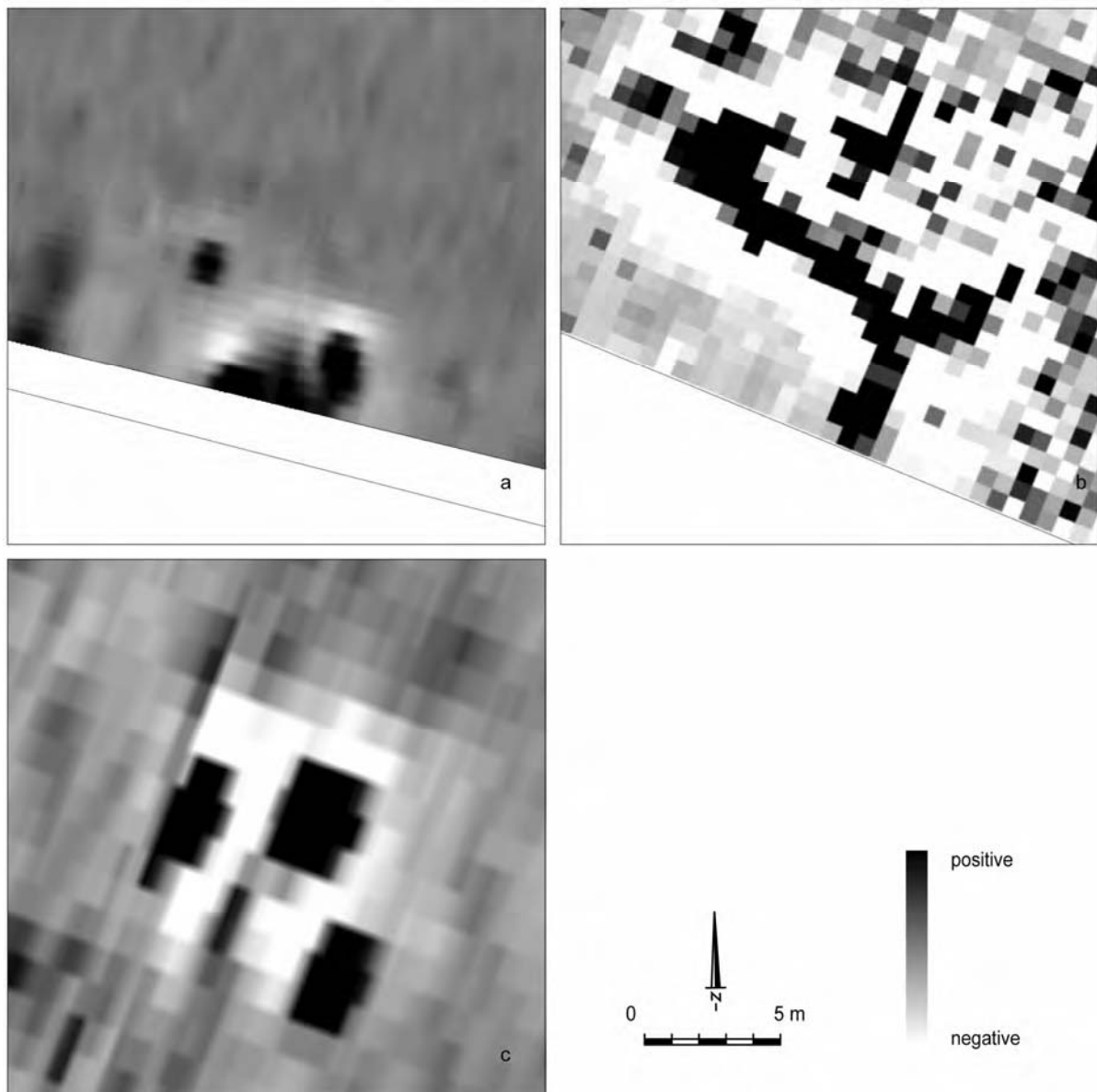


Figure 56 Examples of the magnetic response of furnaces, which are usually characterized by strong positive anomalies with a strong negative halo or trough at the north side of the anomaly.

a: Three furnaces have caused the magnetic anomaly that can be seen in the center of the bottom half the figure. It is not possible to recognize the three individual furnaces in the magnetic response, because the anomalies overlap. A fourth furnace has caused an isolated anomaly, it is located directly north of the other three furnaces. Data from Heeten. Excavation after the magnetometer survey has shown that the metal working furnaces are of the pit furnace type. Data has been interpolated, data range -3 to 3 nT.

b: During the magnetometer survey in Valkenisse, remains of furnaces and metal working debris were observed in the stream bed of the tidal river Scheldt. These remains have caused a y-shaped positive anomaly with a negative halo surrounding it. One of the in situ furnaces is located at the northwestern tip of the anomaly, it appears to have caused a circular anomaly. No other individual features can be recognized in the magnetic response because the anomalies overlap. Data range -5 to 10 nT.

c: Three possible furnaces in Polre. These strong positive anomalies with a strong negative component were interpreted as furnaces after evidence for metal working was found during hand augering over one of the anomalies. Data has been interpolated, data range -7 to 7 nT.

7.5 Infrastructure

7.5.1 Roads

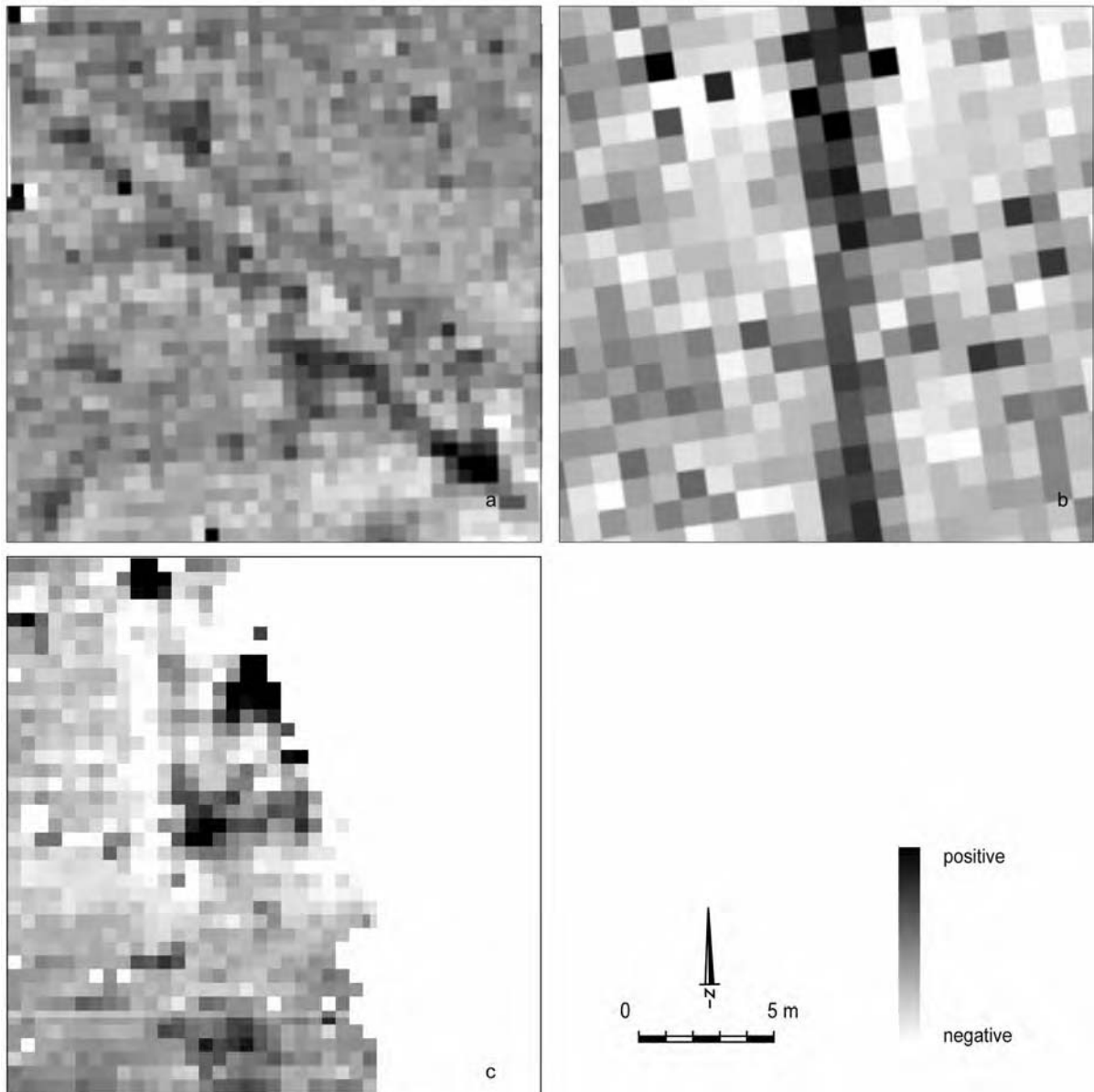


Figure 57 Examples of the magnetic anomalies caused by buried roads and road side ditches.

a: Two parallel road side ditches cause positive anomalies in the Medieval village of Limmen. The fill of the ditches has an enhanced magnetic susceptibility. The interpretation has been confirmed by excavation. Data range -2 to 4 nT.

b: The remains of a road in Smokkelhoek are causing a positive magnetic anomaly. The location of the anomaly corresponds with the location of a road on the 1832 map. Data range -1 to 2 nT.

c: In the data that was collected over the Roman Road in Swalmen, a linear negative anomaly can be seen (north – south direction). Intrusive investigations have not taken place, but it is likely that this anomaly corresponds to one of the road side ditches along the road. Data range -2 to 4 nT.